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ON APPLIED AND PURE SCIENCE

THE terms "pure science" and "applied science" are frequently used at the present time, and usually in a manner that logically either does not differentiate between the two terms, or differentiates on the basis of motives of the devotees. The terms "pure" and "applied" are not happy ones, but I shall point out that there is a logical basis upon which a differentiation may be founded. Applied science includes more than what is embraced in the conventional branches of engineering.

It is sometimes intimated that applied science has to do with the selling or salesmanship side of science, whereas pure science is not so commonplace. Sometimes applied science is the practical, pure science the impractical, that is, something more or less associated with the helpless professor who has specialized to an extent that he is very much akin to the suburban ticket agent whose knowledge of time tables, of stations and of railroads is wholly contained upon one card giving the times of departure and arrival of trains at and from his station to the city station.[1] Sometimes pure science is the free or unrestrained as opposed to the applied or restrained. Indeed, some have it that pure science is the more or less useless as compared with the applied, the immediately useful. Or the pure may be the exact in contrast with the applied. At other times the distinction is made on the basis of the motives of the investigator rather than upon the nature or application of the subject-matter. The one then is the altruistic, as opposed to the selfishly commercial. These differentiations on the basis of motives shade off into the strictly intellectual class distinctions, which may even aver that applied science is not a worthy subject for the mind to entertain. This type of attitude was very general in countries outside of Germany up to recent times. It is of interest to remark that it is almost identical with the attitude that prevailed prior to the sixteenth and seventeenth centuries in regard to the experimental sciences in general, as opposed to other activities of the intellect such as the literary, the philosophic or speculative. So far as motives of the investigator are concerned one can find examples in both pure and applied that will illustrate almost any motive that can be entertained by the human mind. An attempt at differentiation on such grounds is futile. We can

[1] Specialization implies a dynamic and not a passive state. It may well be questioned whether either of these cases represents what is meant by specialization.

find in the humblest mechanic's shop that things are very frequently done for their own sake. Some investigators may pride themselves in that they carry on research for its own sake. This is probably true, but it may be equally true for the lawyer, the physician, the blacksmith, the carpenter, the farmer and indeed may be true for all kinds of activities and for all classes of human beings. The feeling of delight in activity of an intellectual kind is a very close kin to the feeling of delight in activity of a purely physical kind. Of course in the former case the attendant circumstances may be far more complex, having more intimate association with ideals, and perhaps at times involved with a more or less artificial standard of sacrifice. If the difference between the pure and the applied science is only one of motive on the part of the investigator, it means that in most cases we shall not be able to tell whether any particular product of research is pure or applied science. For, as the history of science is recorded at the present time, little attention is paid to any personal traits. In fact, it is a matter of common knowledge that the results of science are respected from whatever quarters of the world they come because they are not personal.

Men guard the products of their experimentation and thinking with about the same zealousness as they guard their purses. One may find any mental state activating in the adding to and the use of the purse. So also one may find almost any mental state activating in the adding to or in the use of the intellectual products for monetary returns or for social recognition and power. At the present time scientific research is a professional matter and to classify the products on the grounds of the motive or motives that may have been the governing factor impelling the particular individual to enter any particular profession will lead nowhere. Scientific research, like any other profession or occupation, may be entered into for destructive and even murderous purposes; witness modern wars and preparation for wars;[2] or it may be entered into by an abnormally zealous mind with the idea of sacrifice for the emancipation of mankind. Usually the impulse lies somewhere between these two, and is intimately coupled with the necessity of making a livelihood in a manner most appealing and commendable to the particular individual.

One may expect that if there is a sufficient contrast between the pure and applied for practical differentiation, there must be also a clear basis, other than personal, upon which a practical judgment may be made; or, at least something associated with the personal motive that may be easily discerned by some one not intimate with the investigator himself. There are immediately evident two possibilities; *viz.*, a differentiation upon the nature of the subject-matter itself and the manner of treating it, or upon the uses to which the subject-matter may be or is put. Classes based upon uses of subject-matter may be numerous and are equally trivial. The subject-matter of one branch of science may be said to be applied when used in another branch, whether in the theory or for practical purposes. Again, the uses of the subject-matter in theory may be set in contrast with the uses in practice, as pure and applied. Experimental work might on this basis be called pure or applied science according as it was undertaken for the sake of the theory or for its possibility of usefulness in commerce and industry (*i.e.*, for the sake of its commoditivity). The viewpoint here becomes coincident with that given in detail below based upon a division of the subject-matter rather than upon the uses of the subject-matter.

If the differentiation is on the grounds of the useful and the non-useful, it remains exceedingly difficult to define what may be meant by the word useful. If this word be taken in a very general sense of having the property or capacity of facilitating activity, physical or mental, in any department of human endeavor, then there remains little if any ground upon which to differentiate not only the products of science but those of art and religion as well. If, however, by useful is meant "that which may be immediately applied to net monetary returns," then it might seem to the business man at least that we have a working definition of pure and applied science. But there is no logic in this definition. Some applied science can never net under ordinary circumstances any monetary returns that a bookkeeper may know it. The best that one may hope for is that the aggregate activities over appreciable intervals of time of a laboratory devoted to applied science shall not have been carried at a monetary loss. The interval of time that one may care to consider in this discussion is an important element. If the interval is too short not even applied science can be useful. From the ordinary business viewpoint the interval may be the ordinary business cycle. For larger and more permanent and extensive industrial establishments the interval becomes longer and even indefinite perhaps. No department of science would welcome it, to be stigmatized as useless. There is probably nothing felt more convincingly than that all the present activities that may be classified as scientific will in due time be useful to mankind at large, and will amply redound in actual material wealth and well-being. The aim of science (perhaps in conjunction with other activities ultimately, too) is the conquest of the universe. This has been the theme of the dreams of master minds

[2] This is instanced because it has professional and social recognition. I am not referring to ignoble and unsocial purposes of social outcasts.

down through the centuries for which history has been clearly written. To entertain that such conquest is futile is to indict the whole of mankind throughout the ages.

The greatest workers in physics have pointed out and in many cases actually carried through certain applications of science: witness the ophthalmoscope of Helmholtz, the miner's lamp of Davy, and many others. Kelvin said: ". . . in physical science many of the greatest advances that have been made from the beginning of the world to the present time have been in the earnest desire to turn the knowledge of the properties of matter to some purpose useful to mankind."

In considering the uses of sciences and the worthwhileness of science one is prone to recall the late wars and to ask semi-philosophic and semi-moral questions. Such uses do not concern us here and may be dismissed with a statement or two. The aims of science in peace time are to construct and to give the maximum of good to the world. The aims of science in wars are to construct as necessity demands only for the one party and to destroy most effectively the best of and to take the most from the other party. There is here not a question of science *versus* wars and destruction, but a peaceful *versus* a warlike state of mind. A state of rationality against a state of irrationality, more or less—a healthy mind against a pathological mind. These states of mind are entertained alike by all levels of society, as is amply recorded during the present and late wars, from those who apparently in peace time pursue scientific research with loftiest ideals, down to those who exist on the verge of mental anarchy. The group impulse overwhelms the individual. All social entities are builders in this world and rise to different scaffolding levels with the ages. As the workers on the ground have only mud and pickaxes with which to build, so they have also only these with which to menace. So, too, every age has its tools, whether for social good or for social menace.

Sometimes a differentiation is made on the grounds of being exact and applied. Such demarcation is more applicable to mathematics as such in contrast to all other sciences. Mathematics strives for the accuracy that only logic can attain. Nothing is too small or too large to be reckoned with. In fact, relative magnitude in general does not set relative importance of quantities, as it does in all other sciences. In physics, for instance, one strives to take account of as small quantities of things as it may be practical or possible in any given experiment to do so. Enormous efforts are made in the perfection of methods and of apparatus in order to take account of smaller and smaller relative amounts of a thing or of the effect. So, in any application of mathematics to physics, summations, for example, are carried out only to such extent as is consistent with the attainments of experiments. In applied science (in general, the engineering sciences) relative magnitudes become even more important. Small relative quantities of any thing or effect are ignored as soon as it is shown that they are of no practical importance; and enormously large quantities are avoided. Accuracy without limit is a characteristic of mathematical logic; accuracy as great as may be attained is the aim in physics; accuracy as good as need be is the practice in engineering.

One sees no practical and logical basis of differentiation between any two phases of science by motives alone, nor by the uses of the subject-matter. We must return, then, to the nature of the subject-matter itself and the manner of treating it, or its interrelations. As has already been hinted at, what is ordinarily clearly classed as applied science is in some way connected with some commodity of commerce. We find also that what is clearly pure science is far removed from any commodity, although sometimes it appears to be intimately associated with a commodity. However, this idea does present a basis for a logical differentiation between pure and applied science. For logic all sciences look to mathematics. Mathematics has also two viewpoints of the pure and the applied mathematics. We may expect, then, that mathematics may be clear on definitions of parts of itself, and perhaps may suggest a basis of definition that is useful in all cases. This is found to be the case.[3] We then may proceed to differentiate between pure and applied science on the basis of subject-matter chiefly and on the manner in which any particular portion of subject-matter is related to the general subject-matter. First, however, a few statements will be introduced to bring out what is meant by certain useful terms, proposition, propositional function, verifiers, falsifiers, that are not commonly found in the physical sciences.

All of the physical sciences have the objective viewpoint. That is, they deal with objects of the external world that exist independently of and outside of ourselves. These objects have various properties, some of which enable the object to stimulate sense organs in what is termed an adequate manner, so as to make us aware of its existence. In general, it is never an isolated body nor a single property of the object that is the stimulating factor. There is always a complex of stimuli to which our sense organs are exposed. Likewise, such complexes of stimuli give rise to complexes of sensations. We analyze the complexes of sensations when we learn about the ob-

[3] In this connection reference may be made to Keyser, "Mathematical Philosophy," Dutton and Co., 1922.

jects of the universe. Abstractions are formed into concepts of things and of relations between things. New things and new relations may be discovered. Many things are found to be related in many ways. These relations, more or less general, are usually referred to as laws. The primary aim of a great portion of science is to discover these laws. The properties of matter and of organisms are studied and compiled in order that new and more general relations may be discerned. Such general relations may be termed propositions, irrespective of whether they have been dignified as laws. Propositions are bound together with other propositions into more general relations and more far-reaching, which in turn may be called propositional functions. Now, pure science is in search of propositions and of propositional functions. Pure science is interested in the special properties of matter only in so far as they are "verifiers" or "falsifiers" of propositions and propositional functions. It must in most cases proceed from the facts of individual species of matter and move on inductively. However, having once established or arrived at a proposition or propositional function, it may proceed deductively. The singular fact is that a proposition or a propositional function may guide into paths not dreamed of during its formulation. So, in fact, we might cite as an illustration of a proposition, that when thinking is logical, the conclusions arrived at are very frequently found to fit experience in far-removed and new fields. Somehow, the guiding that makes us feel that a process of thinking is logical is also connected with the restraining or guiding in the processes of nature. Herein lies the power of mathematical logic when applied to physics or to any other branch of science. A very good illustration of a propositional function in physics is the theory of relativity, with its deduced proposition that electromagnetic wave radiation is subject to gravitation. A particular verifier is the influence of the sun upon a beam of light passing near it.

Pure science, then, deals with the propositions and propositional functions and with properties of materials in so far as they furnish verifiers or falsifiers of the propositions and propositional functions, or in so far as they may be made the basis for new propositions. Applied science, on the other hand, as has already been intimated, is associated with some commodity of commerce or with some substance or thing which is destined to become such. That is, it is concerned with particular verifiers and falsifiers that are directly associated with a commodity. It is interested in all properties which the commodity has and even in those of other commodities and materials that have a bearing upon the commodity in question. It is interested in materials entirely different from the commodity in so far as it may be possible and necessary to have substitutes, either for the purpose of bettering the commodity or the service it renders, or for the purpose of controlling the market more efficiently. Here is noted an element of restraint in applied science that apparently did not enter into pure science. This is not, however, a clear difference between the two. Much of applied science is as individualistic as most of pure is. But the products of applied science have a social judgment placed upon them much sooner in general than those of pure science. After such social judgment has been made and especially if favorable or encouraging, a portion of the science thereafter connected with the product always remains more social, for then it means that the product is destined to be a commodity or closely associated with a commodity in some more or less direct manner. This portion (*i.e.*, the more social) will be under restraint, for a commodity is essentially a social thing and modern industry requires the concentrated efforts of talent, capital and labor. These restraints are not inherent in the subject-matter in general of applied science, nor in the mind of the investigator, but lie in the organization or institution responsible for the commodity. Or, they may lie in the mutual agreement between two or more organizations or institutions, or in the ethical coercion that may have grown up in any realm of thought or activity. The individual who does the technical or research work is selected so that his activities resulting in important developments—from whatsoever motive so far as he himself is concerned—may fit into the restrained order of things. It is obvious that this is not a restraining that exists in or is peculiar to industrial laboratories only where most of the scientific work done is applied science; and that such restraints exist in other institutions as well. In scientific institutions that are endowed for a particular purpose the same restraining influences manifest, and in other educational institutions as well. Some kind of restraint is inevitable in any social undertaking.

There are various attributes that are frequently assigned to either pure or applied science which now are obviously only part descriptions in the light of these definitions. For instance, consider the matter of patentability. Letters patent, copyrights and franchises of any kind are essentially applicable to commodities or to processes related directly to commodities. Propositions and propositional functions are not subjects patentable. We might expect, then, that applied science and not pure science should concern itself about them. The attributes of timeliness and of being individualistic are possessed the more or less by applied science according as the commodity with which the applied science is associated possesses them. Again, because a portion of applied science requires greater social co-operation than most of pure

science generally does, the matter of proper units and standards wherewith to gauge the performance and composition of the commodity in a manner that will have unity of meaning and universal acceptance, is very early of serious concern to applied science.

If, then, we must use the terms pure and applied science, a differentiation based on the grounds of subject-matter and relationships found in the subject-matter is the more preferable. Applied science deals with the properties of commodities, or with properties of materials more or less directly connected with the production, distribution or utilization of commodities. It is interested in pure science in so far as the latter may give the general formulas by which particular behavior may be foretold, or the behavior of one kind of material may be compared with that of another kind which is involved in a given commodity or may become a substitute for the commodity. In addition, applied science is interested in pure science in so far as any particular verifiers or falsifiers may suggest new kinds of commodities, or new ways of effecting the production, distribution and utilization of commodities. Pure science is concerned with the propositions and propositional functions of science. It is interested in applied science in so far as the latter may furnish particular verifiers and falsifiers of propositions and of propositional functions. In addition, it is interested in applied science in so far as the data may suggest new avenues to new propositions.

ENOCH KARRER

NELA RESEARCH LABORATORIES,
CLEVELAND, OHIO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE LOS ANGELES MEETING

THE preliminary announcement of the seventy-seventh meeting of the American Association for the Advancement of Science to be held with the seventh annual meeting of the Pacific Division and the fourth annual meeting of the Southwestern Division at Los Angeles, from September 17 to 30, will shortly be mailed to the members. It is an attractive folder reflecting credit upon the Los Angeles committee on arrangements which assumed the entire expense of printing this announcement as well as the final program which will be distributed at the meeting in September. The well-known enterprise and hospitality of the Los Angeles people, together with its unique advantages as a convention city, gives assurance that the sojourner will be well taken care of and every provision made for the success of the meeting.

The total eclipse of September 10, which centers in the vicinity of Los Angeles, will occasion the presence of many distinguished astronomers from all parts of the world. A diagram of the path of the eclipse is presented in the folder with a table showing the duration of totality for various places. Quoting from the announcement the eclipse "will be of especial interest to astronomers and other scientists because of the unusual opportunity it will afford for undertaking observations with exceptionally powerful and complete equipment. This is due to the accessibility of much of the area within which the eclipse is total. The path of totality passes close to Los Angeles and over San Diego and many other towns which have excellent transportation facilities. Furthermore, the eclipse occurs at a season of the year and at a time of day when the prospect of clear skies is very good, as is shown by records extending over many years."

Naturally, astronomy will be featured rather strongly at the Los Angeles meeting. Detailed reports of observations of the eclipse are of course not to be expected. The astronomers in attendance will however meet under the auspices of the association, holding joint sessions of Section D with the thirtieth meeting of the American Astronomical Society, and the summer meeting of the Astronomical Society of the Pacific. These sessions will be held at the University of Southern California, the Laboratory of the Mount Wilson Observatory and the California Institute of Technology.

A symposium on "Eclipses and Relativity," with Dr. W. W. Campbell, president of the University of California; Dr. Charles E. St. John, of Mount Wilson Observatory, and Dr. S. A. Mitchell, of the University of Virginia, as speakers, will be a feature of the general sessions at the University of Southern California.

A Research Conference will be held Monday at noon, September 17, during the luncheon period. The encouragement and coordination of research work on the Pacific Coast will be discussed and delegates will be heard from the various universities and research institutions in this field.

The Los Angeles meeting will be formally opened Monday evening, September 17, in the Bovard Auditorium, University of Southern California, with an address by President E. P. Lewis, of the Pacific Division of the American Association for the Advancement of Science, following which the usual public reception will be held.

On Monday afternoon, September 17, the symposium on "Eclipses and Relativity" will be held. It is represented that this discussion will be judiciously bereft of some of its inherent technicalities and suited to the comprehension of the average layman. It will prove a most attractive feature of the general sessions.

A banquet will be arranged for Tuesday evening, September 18, at 6:30 for all members of the asso-

ciation and affiliated societies. Following the dinner, adjournment will be taken to Bovard Auditorium, where at 8:00 P. M. an address will be given by Dr. John C. Merriam, president of the Carnegie Institution of Washington. Dr. Merriam has chosen for his subject the famous La Brea Deposits with the discovery and exploitation of which he has been closely connected. A wonderful display of fossils from Rancho La Brea is on exhibit at the Museum of History, Science and Art, a short distance from Bovard Auditorium.

On Wednesday evening, September 19, an address will be given by Dr. R. B. von Kleinsmid, president of the University of Southern California, "Science in its Relationship to Liberal Education."

MEETINGS OF SOCIETIES

Twenty-five affiliated societies announce meetings to be held under the general auspices of the association. Except in the case of the astronomical societies, some of whose meetings will be held in Pasadena, these meetings will all be accommodated in the George Finley Bovard Administration Building of the University of Southern California. The American Association of Petroleum Geologists will hold its regular meetings from September 20 to 22, immediately following the period announced for the other meetings.

The following societies are planning to hold meetings:

The American Association of Economic Entomologists
The American Association of Petroleum Geologists
The American Astronomical Society
Section D (Astronomy), The American Association for the Advancement of Science
The Astronomical Society of the Pacific
The American Chemical Society, California Section
The American Chemical Society, Southern California Section
The American Meteorological Society
The American Physical Society
The American Phytopathological Society, Pacific Division
The Cooper Ornithological Club, Northern Division
The Cooper Ornithological Club, Southern Division
The Cordilleran Section, The Geological Society of America
The Ecological Society of America
The Lorquin Natural History Club of the Southwest Museum
The Pacific Coast Branch Paleontological Society
The Pacific Coast Entomological Society
The Pacific Division of the Plant Physiological Section of the Botanical Society of America
The Pacific Fisheries Society
The San Francisco Section, The American Mathematical Society
The San Francisco Society, The Archeological Institute of America
The Seismological Society of America
The Southern California Section, The American Society of Mammalogists
The Western Psychological Association
The Western Society of Naturalists

W. W. SARGEANT,
Secretary, Pacific Division

THE NEW MARINE BIOLOGICAL RESEARCH STATION OF THE BERGEN MUSEUM, NORWAY

THE first marine biological station in Norway was built in 1891. It was situated in the city of Bergen and was connected with the museum there, where investigations of the particularly rich marine fauna of the west coast of Norway have formed the chief part of the zoological work for almost one hundred years.

For thirty years this first biological station was of great importance to Norwegian and foreign scientists; but it then became necessary to discontinue it, owing to the increasing pollution of the available sea-water, caused by the growth of the city.

Thanks to the generosity of private individuals it has been possible for the Bergen Museum to build a new and larger biological station, now finished and open for workers.

The station is situated on the island of Herdla in the archipelago, about 17 miles from Bergen. This locality has been chosen so as to assure a perfect supply of sea-water, and so that the laboratories are situated as close to the working field as possible. From this place one is able to reach any of the biological localities typical of the west coast of Norway in the course of two hours' sailing at most. Furthermore, the short distances to be covered are important because the greatest difficulties attend the transport of the more frail marine organisms from the place of capture to the aquaria in the laboratories, and the animals are often dying or dead when they reach there. It has thus been possible to keep for eight months in the aquaria crustaceans caught at a depth of 300 metres.

The west coast of Norway offers a very rich field for marine biological work, and owing to the great variety of bottom and depth, the fauna is correspondingly varied. The archipelago, consisting of many smaller and larger islands, also makes the sea-surface calm enough for this kind of investigation, in spite of the proximity of the open Norwegian Sea. Finally, this locality has the great advantage that the sea never freezes over, and it is thus possible to collect material throughout the winter, while at places even further south ice conditions prevent this.

The station building contains five laboratories and a larger room for instruction purposes. During the summer ten scientists can be accommodated, and dur-

ing the winter five, besides the staff. On the second floor are the library and private rooms for the visiting scientists, who also get their board at the station, at reasonable cost.

Besides smaller boats the station owns a special vessel, the "Herman Friele," of 23 tons, constructed for all kinds of marine investigations.

The opportunities for working at this station are open to scientists of all countries. There are no fees for this, because it is considered to be the main objective of the station to promote marine investigations as fully as possible. For the present no regular investigations are planned by the station, as it is the purpose to supply the scientists working there with as much material as possible for their investigations. As conditions improve, it is proposed that the station take up again the international courses of instruction in marine investigations carried on until 1914 at the Bergen Museum, and which met with so great a response from the different countries of Europe. Scientific workers who are interested in securing opportunities for a stay at this station are requested to communicate with the writer.

AUG. BRINKMANN, *Director*

BERGEN MUSEUM,
BERGEN, NORWAY

SCIENTIFIC EVENTS

MEMORIAL PORTRAIT OF ALFRED RUSSEL WALLACE

A MEMORIAL portrait of Dr. Alfred Russel Wallace, joint author, with Darwin, of the theory of natural selection, was unveiled on June 23 at the Natural History Museum, South Kensington, by Sir Charles S. Sherrington, President of the Royal Society. The present year is the centenary of Dr. Wallace's birth.

Sir James Marchant offered the portrait to the trustees on behalf of the memorial committee, and after unveiling it, according to the report in the London *Times*, Sir Charles Sherrington said:

The portrait that has a fitting place within the walls of this building in memory of Alfred Russel Wallace will be cherished for many reasons here. To those great collections for which this building is the house and the shrine he contributed generously and largely. Much of the fruit that he gathered in his expeditions in the Malay Archipelago enriches the galleries here. But he did even more for this collection and for all collections of natural history throughout the world by contributing a renowned and fertile idea which has lent and lends them a further significance and a new meaning. He contributed an interpretation which forms a guiding thread to a great deal of the study which such collections as this render possible. He and his great compeer (Darwin), by whose statue we stand now, gave a further setting to the whole of the arrangements of such a museum as we are now in, and much of their interpretation, much of their study, bears, further, the great interest that it has applications even to human society itself. To Wallace, ardent, relatively young, intensely curious into the economy of nature, and faced with the prodigality, the almost wasteful luxuriance of nature in the tropics, there arose the idea to which has been given a term that has passed into common parlance—the "struggle of existence" in animate nature in relation to and in its bearing upon the origin of all that astounding, varied manifoldness of feature that the world exhibits—the origin of species. And that idea, taking its growth from him and from his great, his illustrious friend and colleague, has since that time, since he formulated it even briefly, been, I suppose, and stands still, the dominant underlying motive that guides the study and arrangement of these collections. I suppose that that happy circumstance of the juxtaposition of the portrait that we see there and of the statue by which we are standing represents in collocation the commemoration of two men of whom it may be said, perhaps, that never a day passes but their two names rise to the memories of the director and the distinguished staff who are with him to study and to help others to study these collections. Circumstances arranged that the discoveries of these two men came, as it were, at the same moment and on the very same theme side by side before the scientific world. Such an attendant circumstance might, in some cases, have proved an embarrassment to one or other of them, but, as we all know, instead of being an embarrassment it formed a bond of generous association between them, each one of them striving to exalt the merits of the other. That part of the history of science will ever remain as a noble and inspiring feature connected with the work of these two men. Therefore the picture that we have there is not only a memorial of one whose memory is part of the historic treasure of science, but it will also be an abiding source of inspiration for the future, inasmuch as it represents a noble trait of character as well as genius, which went together in the personality of Alfred Russel Wallace.

Professor E. B. Poulton, F.R.S., spoke on Wallace's life and work, and also bore testimony to his generous character and to the enthusiasm with which he entered into and promoted the scientific work of others; and the Archbishop of Canterbury expressed the ready welcome which the trustees gave to that striking portrait of a remarkable man.

THE ZOOLOGICAL RECORD

DR. WITMER STONE, executive curator of the Academy of Natural Sciences, Philadelphia, and chairman of the library committee, has addressed the following letter to zoological and other societies in America:

In SCIENCE for May 18, 1923, page 577, is published a letter from Mr. P. Chalmers Mitchell, of The Zoological Society of London, on the financial status of *The Zoological Record*. It states that the annual loss to the society on the issues of the *Record* is over £1,100 and is likely to increase; that a statement issued by the Council of

the Zoological Society in the Spring of 1922, addressed to zoologists and zoological institutions throughout the world, asking for support, has produced an unsatisfactory response; that, unless substantial help is forthcoming, the *Record* will be discontinued; but that the Zoological Society is "ready to continue the *Record*, and to regard a loss of £500 a year as part of our contribution to the common good of zoological science, if other institutions guarantee us against further loss."

The Library Committee of the Academy of Natural Sciences of Philadelphia has been authorized by the Council of the Academy to offer to the Zoological Society of London a guarantee of One Hundred Dollars toward any deficit that may arise during the year ending July 1, 1924, resulting from the publication of the volume of the *Record* issued during that year, and to communicate its action to other zoological institutions, inviting them to take similar action.

We believe that the discontinuance of *The Zoological Record* would be unquestionably a great calamity to zoologists everywhere. We would therefore urge you to consider, as soon as possible, the question of offering a sum to the Zoological Society of London as a contribution to the guarantee fund asked for in Mr. Mitchell's letter and to communicate any affirmative action to the undersigned and to send any contribution direct to the Zoological Society at Regent's Park, London, N. W. 8.

THE REMOVAL OF THE DIRECTOR OF THE RECLAMATION SERVICE

ENGINEERS are protesting against the removal of Arthur P. Davis as director of the U. S. Reclamation Service. Secretary Work's action is characterized as prejudicial to the public interest and the secretary is described as pursuing a dangerous course. The Federated American Engineering Societies have raised formal and vigorous objection to the displacement of Director Davis. The position of the federation is explained in a statement by Executive Secretary L. W. Wallace, in which he says:

> Because of the far-reaching results that might ensue and because of the seriousness of the situation, the organized engineers and technical men of the United States are preparing to make a thorough search into the considerations that led to the action taken in regard to the Reclamation Service. The American Society of Civil Engineers has appointed a special committee to investigate the matter. The public affairs committee of the Federated American Engineering Societies, of which J. Parke Channing of New York is chairman, has already addressed a letter of inquiry to the secretary of the interior concerning the action.
>
> This is being done not from the standpoint of questioning the right of a Government official to discharge any one that he may elect, but from the point of view of the wisdom of the announced policy that a technical bureau can be more effectively directed by a man not technically trained and fitted in comparison with one so technically trained and fitted.

The work of the Reclamation Service is essentially engineering and technical. There are business aspects, to be true, but so far as is known there has been no criticism of the business direction of the Service, other than perhaps by certain interests in the West who have endeavored to secure a reduction in or have endeavored to repudiate payments for reclaimed lands purchased.

Should this demand prevail, the fundamental principle of the enabling act will be displaced and the revolving fund for the continuation of the work will be dissipated, so that other needed projects can not be carried out unless there be additional drains upon the Treasury of the United States. Furthermore, should such an eventuality ensue public confidence in the integrity of the direction of such work would be so shaken as to make it difficult to secure appropriations from Congress to extend the work of reclaiming the arid lands of the west.

In the main, the support for such has come from the West, but should there be a question as to the wisdom with which the projects are selected and executed, then it is entirely probable that the West would not receive support from other sections of the country. Therefore, not only is the morale of the technical service at issue but also the larger thing, perhaps reclamation itself.

INTERNATIONAL CONGRESSES OF PHYSIOLOGY AND PSYCHOLOGY

THE eleventh International Physiological Congress, which will be held at Edinburgh on July 23–27, under the presidency of Sir Edward Sharpey Schafer, is apparently the first scientific meeting of its kind in Scotland, and promises to be very successful. Already more than 250 physiologists from various parts of the world have signified their intention of attending the meeting, and a large number of countries will be represented. The largest contingent from abroad is coming from the United States and Canada, and will number about forty. A second notice has just been circulated, from which we see that, on presentation of an official voucher, return tickets to Edinburgh will be issued at a single fare and a third by any railway booking office in Britain. The provisional program of the congress includes a reception by the Lord Provost of Edinburgh and an address by Professor J. J. R. Macleod, of Toronto, on insulin. Those who intend to take part in the congress should, unless they have already done so, communicate with one of the secretaries, Professor G. Barger or Professor J. C. Meakins, University of Edinburgh.

The seventh International Congress of Psychology will be held at Oxford on July 26–August 2, and will differ from preceding congresses in that it will be restricted to 200 members, membership being confined to trained psychologists, and a few others approved by the committee. It is hoped to provide international symposia on subjects of present interest, the contributions being circulated in advance, and each

day will be devoted to a different aspect of psychology (general, educational, industrial, medical, social, etc.). The mornings will be occupied in the discussion of more general problems (such as the perception of time, the perception of form, the nature of general ability, the concepts of mental and nervous energy, the principles of vocational testing, the psychological value of certain psychoanalytic views), and the afternoons in the presentation of a limited number of papers offered by individual members. Exhibits of apparatus and less technical lectures will be also arranged. The recognized languages of the congress will be English, French, German and Italian.—*From Nature.*

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION

THE "Preliminary Program and Invitation Circular" for the approaching Liverpool meeting of the British Association for the Advancement of Science has recently been received. The meeting will occur from Wednesday, September 12, to Wednesday, September 19. Members of the American Association have been cordially invited to attend the meeting and those planning to be present may secure copies of the Preliminary Program, etc., by applying to the Secretary of the British Association, Burlington House, London, W. 1. They are requested also to inform the Washington office of the American Association. It is desirable that our own records show approximately the number of our members who attend the British Association meeting. The Local Secretaries' office for the meeting will be in the Manesty Building, College Lane, Liverpool, till September 10. The Reception Room for the meeting will be at St. George's Hall.

The Liverpool meeting will be under the presidency of the noted physicist, Professor Sir Ernest Rutherford, and it will be the ninety-first annual meeting of the British Association. The inaugural general meeting will occur at 8:30 P. M., on Wednesday, September 12. At this meeting Sir Ernest Rutherford will deliver the presidential address, on "The electrical structure of matter." On the following days will occur the addresses of the sectional presidents, which are announced as follows:

Section A (Mathematics and Physics). Professor J. C. McLennan, on *The Origin of Spectra.*

Section B (Chemistry). Professor F. G. Donnan, on *The Physical Chemistry of Interfaces.*

Section C (Geology). Doctor Gertrude Elles, on *Some Aspects of Evolutional Paleontology.*

Section D (Zoology). Professor J. H. Ashworth, on *Modern Zoology: its Boundaries and some of its Bearings on Human Welfare.*

Section E (Geography). Doctor Vaughan Cornish, on *The Position and Opportunity of the British Empire.*

Section F (Economic Science and Statistics). Sir W. H. Beveridge, on *Unemployment and Population.*

Section G (Engineering). Sir H. Fowler, on *Transport and its Indebtedness to Science.*

Section H (Anthropology). Professor P. E. Newberry, on *Egypt as a field for Anthropological Research.*

Section I (Physiology). Professor G. H. F. Nuttall, on *Symbiosis in Animals and Plants.*

Section J (Psychology). Mr. C. Burt, on *The Mental Differences between Individuals.*

Section K (Botany). Mr. A. G. Tansley, on *The Present Position of Botany.*

Section L (Educational Sciences). Professor T. P. Nunn, on *The Education of Demos.*

Section M (Agriculture). Doctor C. Crowther, on *Science and the Agricultural Crisis.*

Numerous discussions are announced, some of the topics being: *Cohesion and Molecular Forces, Vocational Tests for Engineering Trades, The Physical Chemistry of Membranes in relation to Physiological Science, The Delinquent Child* and *Virus Diseases of Plants.*

Saturday, September 15, is to be devoted to excursions. An exhibition of scientific apparatus is being organized and a meteorological demonstration is being arranged.

The annual meeting for 1924 will be held in Toronto, Canada.

BURTON E. LIVINGSTON,
Permanent Secretary, A. A. A. S.

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

THE American Association of Petroleum Geologists will hold a mid-year meeting in Los Angeles on September 20, 21 and 22. The program will be devoted to (a) papers on geologic theory with special reference to the origin and occurrence of oil and gas, (b) papers on the geology and development of California oil fields, and (c) papers on geologic problems in the major oil regions, domestic and foreign. The sessions promise to be specially interesting and unusually rich in contributions to geologic theory.

The meeting follows immediately the Special Summer Meeting of the American Association for the Advancement of Science, and at the same place, making attendance at both meetings particularly convenient. The American Association of Petroleum Geologists hopes that many, perhaps all, of those attending the earlier meeting may remain over for the latter. Every member of the American Association for the Advancement of Science, whether geologist or not, will find this meeting interesting and profitable, and every member is warmly invited to attend and to take part in the discussions.

MAX W. BALL,
President

SCIENTIFIC NOTES AND NEWS

AT the congregation of the University of Cambridge, England, held on June 12, the honorary degree of doctor of science was conferred upon Dr. William Henry Welch, director of the School of Hygiene and Public Health of the Johns Hopkins University.

AT the commencement exercises of Oberlin College on June 20, the honorary degree of doctor of science was awarded to Professor Charles J. Chamberlain and Professor Henry C. Cowles, both of whom are members of the staff of the department of botany of the University of Chicago. Professor Chamberlain was a member of the Oberlin class of 1888, and Professor Cowles of the Oberlin class of 1893.

DRURY College, on the occasion of its fiftieth anniversary, May 30, conferred upon Benjamin F. Finkel, Ph.D., of the chair of mathematics, and on Edward M. Shepard, Sc.D., retired professor of geology, the honorary degree of LL.D.

GERALD SWOPE, president of the General Electric Company, Schenectady, N. Y., received the honorary degree of doctor of science from Rutgers College and the State University of New Jersey, at the commencement exercises on June 12.

CLARENCE L. LAW has been elected president of the Illuminating Engineering Society for the coming year.

DR. FREDERICK B. POWER, in charge of the phytochemical laboratory of the Bureau of Chemistry, Washington, D. C., was recently elected to honorary membership in the New York State Pharmaceutical Association.

PROFESSOR NILS BOHR was made an honorary member of the Cambridge Philosophical Society and received the honorary degree of doctor of science from the University of Cambridge on June 12.

THE Albert Medal of the Royal Society of Arts has been awarded this year in duplicate to Sir David Bruce and Sir Ronald Ross, in recognition of the eminent services they have rendered to the economic development of the world by their achievements in biological research and the study of tropical diseases.

DR. MATTHIAS NICOLL, JR., has been appointed to succeed the late Dr. Hermann M. Biggs as New York State Commissioner of Health.

THE Ohio Agricultural Experiment Station announces that the position of nutrition chemist in the department of animal industry has been filled through the appointment of Roland M. Bethke, Ph.D., Wisconsin, '23.

DR. JOHN PALIBIN, director of the Botanical Garden at Batoum, has accepted the post of assistant to the museum director in the botanical garden of Petrograd.

AT the annual meeting of the New York State Association of Consulting Psychologists the following officers were elected: *President,* Dr. David Mitchell; *Vice-President,* Dr. Mark A. May; *Secretary-Treasurer,* Miss Elizabeth A. Walsh; *Member of the Executive Committee,* Dr. Dean R. Brimhall, to fill out the unexpired term of Dr. Ruth Swan Clark, who has resigned.

Nature announces the resignation of Sir George Beilby after nearly seven years' voluntary service as director of fuel research and chairman of the Fuel Research Board under the Department of Scientific and Industrial Research, which was established in 1917 to investigate the nature, preparation and utilization of fuel of all kinds. Dr. C. H. Lauder has been appointed director of fuel research and Sir Richard Threlfall, a present member of the board, chairman. Sir Charles Parsons will continue as a member of the board for a further period. Sir George Beilby retains his membership of the advisory council of the department and has consented to act as honorary adviser to the board. The following have been appointed additional members: Mr. R. A. Burrows, Sir John Cadman, Dr. Charles Carpenter, Mr. Samuel Tagg, Sir James Walker and Professor R. V. Wheeler.

THE following named fellows of the American Association for the Advancement of Science have been appointed as official representatives of the Association at the approaching meeting of the British Association for the Advancement of Science, which will occur from September 12 to 19 at Liverpool: S. C. Brooks, biologist, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.; Frederic S. Lee, professor of physiology, College of Physicians and Surgeons, Columbia University; G. N. Lewis, professor of chemistry and dean of the College of Chemistry of the University of California; A. P. Mathews, head of the department of physiological chemistry of the University of Cincinnati; A. R. Moore, professor of physiology at Rutgers College; William A. Noyes, professor of chemistry and director of the chemical laboratory of the University of Illinois.

MR. ELMER D. MERRILL, director of the Bureau of Science, Manila, will represent the Bureau of Science at the second Pan-Pacific Science Congress to be held in Sydney and Melbourne in August.

DR. S. C. BROOKS and Dr. M. M. Brooks, biologist and assistant biologist, respectively, of the Hygienic Laboratory, Washington, D. C., will spend the sum-

mer abroad visiting various scientific laboratories and attending the Eleventh International Physiological Conference at Edinburgh.

A. A. JOHNSON, formerly director of the Institute of Applied Agriculture at Farmingdale, L. I., has just returned from a three months' trip to Russia where he had gone to represent American machinery interests and to make arrangements for American participation at the Industrial Exhibition at Moscow in August. Mr. Johnson, in 1921, was appointed chairman of the Russian Relief Commission to investigate famine conditions and to make recommendations.

DR. WILLIAM WALTER CORT, associate professor of helminthology in the School of Hygiene and Public Health of the Johns Hopkins University, has sailed from San Francisco for Peking, where he will serve as exchange professor in parasitology in the Peking Union Medical College during the next academic year. Dr. N. R. Stoll, graduate student in the School of Hygiene and a research fellow under appointment by the Rockefeller Foundation, accompanied Dr. Cort.

HARLAN I. SMITH, of the National Museum of Canada, is continuing his researches in the Bellacoola area of British Columbia. He is also arranging for Mackenzie Park, a proposed out-of-door museum, forest reserve and animal sanctuary, as a monument to Sir Alexander Mackenzie, the first white man to cross Canada.

DR. LAFAYETTE B. MENDEL, professor of physiological chemistry in Yale University, who has been giving a course of lectures at the University of California, recently addressed a symposium of physicians in Los Angeles, the Santa Barbara County Medical Association, the California Academy of Medicine, the San Francisco Dental Society, the students of Mills College, Oakland, and other groups along the Pacific Coast upon topics pertaining to nutrition.

DR. HENRY B. WARD, national president of Sigma Xi, addressed the Sigma Xi Club of Southern California on the evening of June 16 at the Maryland Hotel, Pasadena, on "The Future of Sigma Xi." Professor Ephraim Miller, formerly of the University of Kansas, who has passed his ninetieth birthday, was present and spoke briefly.

DR. EDWARD V. B. HARLEY, professor of pathological chemistry in University College, London, died suddenly on May 21, aged fifty-nine years.

FORMAL dedication of the Irving Porter Church telescope recently installed in Fuertes Observatory, Cornell University, was held at Rockefeller Hall during commencement week. The main address was made by Dr. H. D. Curtis, director of the Allegheny Observatory, who traced the influence of astronomy on modern thought.

ONE of the new buildings of the University of Alabama School of Medicine, Tuscaloosa, will be named after Josiah Clark Nott, the founder of the Medical College of Alabama, Mobile, 1859. The college was removed to Tuscaloosa in 1920.

LIEUTENANT-COLONEL JAMES CURRIE ROBERTSON, formerly sanitary commissioner with the government of India, died on May 14.

THE death is announced from Brazil of M. Chrostowski, the Polish ornithologist. M. Chrostowski was well known through his investigations into the tropical fauna of South America in the little known districts of Iguaca and Rio Negro. He was the author of numerous books published in Polish, English and French. According to a Reuter despatch, in company with another Polish ornithologist, he embarked on an expedition to Brazil in 1921 at his own expense, and was preparing to return to Poland when he succumbed to marsh fever.

WE learn from the *Journal* of the American Medical Association that Count Matsuda, ambassador from Japan, accompanied by the high officials of the Japanese embassy, recently deposited two beautiful vases, representing Japanese art, in the crypt of the tomb of Pasteur, at the Institut de la rue Dutot. The ambassador has also turned over to Dr. Roux, director of the Pasteur Institute, the sum of 108,000 francs, collected by the scholars and scientists of Japan. In a short presentation address, Count Matsuda gave expression to the admiration and gratitude felt by his compatriots for the work of Pasteur. Dr. Roux, in turn, expressed his thanks in the name of his colleagues and emphasized the fact that Japan was one of the nations which had understood how best to apply the discoveries of Pasteur, not only for the protection of public health but also for the progress of their industries, especially the raising of silkworms. He also referred to the valuable contributions to science made by Japanese scientists, several of whom had worked in the laboratories of the Pasteur Institute at Paris.

ARTHUR WILLIAM BACOT, entomologist to the Lister Institute of Preventive Medicine, lost his life a little more than a year ago in the course of an experimental inquiry into the rôle of the louse in the transmisison of typhus. We learn from *Nature* that several of Mr. Bacot's friends and colleagues have thought that some memorial of him ought to be established in the village where he resided and, before his appointment to the staff of the Lister Institute, carried out important medico-entomological researches. Bacot entered the ranks of specialist investigators from those of ama-

teur naturalists and nature students, and always attached the greatest importance to the teaching of nature study in the elementary schools. His colleagues and friends believe that the form of recognition which would have been most congenial to his feelings would be the provision of assistance to the authorities of the council schools in his home (Loughton) in furthering the study of natural history. With that object, a fund has been opened—the Bacot Memorial fund.

AN international memorial apicultural library dedicated to the memory of Dr. Charles C. Miller, a famous American beekeeper, of Marengo, Illinois, has been established at the University of Wisconsin. A sum of $1,500 to $2,000 has been donated by beekeepers from all parts of the world, and the interest from this sum will be used in making additions to the library. Many hundreds of volumes of journals and books have been donated by beekeepers and scientists, and it is the plan of the committee in charge to make this one of the best apicultural libraries in the world. The library is to be dedicated at a conference of beekeepers to be held at Madison, Wisconsin, during the week of August 13 to 18. Many prominent authorities on the subject of apiculture will attend the meeting and give addresses on some phase of this subject. On Saturday of that week, a pilgrimage by automobile will be made from Madison to Marengo, Illinois, where the dedication ceremony will be conducted and a memorial tablet placed in the church.

BURT P. GARNETT, who has been technical manager of the A. C. S. News Service and managing editor of the News Edition of the *Journal of Industrial and Engineering Chemistry,* has launched a news syndicate under his own name in Washington. This work will consist of the preparation of articles for the newspapers and magazines on technical and scientific subjects. Hereafter the publicity work of the Society will be in charge of James T. Grady, director of the department of public information, Columbia University. The managing editorship of the News Edition has been entrusted to Dr. Robert P. Fischelis, dean and professor of pharmaceutical chemistry at the New Jersey College of Pharmacy, Newark, N. J. Dr. Fischelis has been a member of the staff of *Industrial and Engineering Chemistry* for several years.

OWING to the death of Dr. Harold C. Ernst, Boston, editor of the *Journal of Medical Research* since 1896, that journal has become the property of the American Association of Pathologists and Bacteriologists and will be published in the future by a board of editors appointed by the council of the association. It will be devoted to the prompt publication of original observations and investigations in the field of pathology. Communications should be addressed to the editor-in-chief, Dr. F. B. Mallory, Boston City Hospital, Boston.

THE National Academy of Sciences will hold its autumn meeting at Cornell University in November.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Denver has received the largest single gift in its history in the form of real estate property valued at $1,500,000 from James H. Causey, Denver business man and former partner of Governor Sweet, of Colorado. Mr. Causey has placed no restrictions on the use to which the gift shall be put, although in a letter to the board of trustees he stated that he would like to see the income used for "the creating of international, social and industrial good will."

TUFTS College dedicated on June 16 the new chemical laboratory built at a cost of $300,000, which will be ready for use in the fall. Addresses were made by Professor Arthur B. Lamb, of Harvard University, and by Professor Charles A. Kraus, of Clark University. Dr. Arthur Michael, formerly professor of chemistry at Tufts, was the guest of honor. In addition to this new equipment, the college has just completed its campaign for a $1,000,000 endowment fund.

DR. W. A. HAMILTON, professor of mathematics at Beloit College, and Dr. E. S. Haynes, professor of astronomy, have resigned their positions in protest at the action of the board of trustees, who forced the resignation of Professor C. L. Clarke, dean of men at Beloit, in order to make way for the appointment of another member of the faculty to the deanship. Both Dr. Hamilton and Dr. Haynes were members of an administrative committee which has been in charge of the college since the resignation of President M. A. Brannon last winter.

DR. HENRY D. JUMP, Philadelphia, has accepted the chair of applied therapeutics in the Woman's Medical College. This fills one of the vacancies caused by faculty resignations when the Board of Corporators refused to reappoint Dr. Alice Weld Tallant to the chair of obstetrics at the college.

HERBERT S. HADLEY, formerly governor of Missouri, has been elected chancellor of Washington University (not of the University of Missouri as was incorrectly stated in last week's issue of SCIENCE). Dr. Hadley has been professor of law in the University of Colorado since 1917. He succeeds Dr. Frederic A. Hall, formerly professor of Greek, who became acting chancellor when Chancellor David F. Houston became secretary of agriculture, and was elected chancellor in 1917.

AT the University of Minnesota, Associate Professors Richard M. Elliott, William S. Foster and Donald G. Paterson, of the department of psychology, have been promoted to the rank of professor. Dr. Charles Bird has been promoted to be assistant professor of psychology.

DR. ISRAEL MAIZLISH has been appointed instructor in physics at Lehigh University.

DR. H. S. RAPER, of the University of Leeds, has been appointed professor of physiology at the University of Manchester.

DR. R. J. S. MCDOWALL, lecturer in experimental physiology and experimental pharmacology at Leeds, has been appointed professor of physiology at King's College, London.

DISCUSSION AND CORRESPONDENCE

MARINE WILCOX IN MEXICO

RECENTLY, the East Coast Oil Company, S. A., under my direction, drilled a deep test on Idol Island, which is in the Tamiahua lagoon about sixty miles south of Tampico. The location was made on what we hoped was the extension of one of the producing anticlines to the south. When oil in commercial quantity was not found at expected depth, the well was continued for exploratory purposes. The samples were carefully taken and the results from their study are of great interest and we hope to publish them shortly. In this notice it is only intended to discuss a single horizon found there. The method used in examination of samples was that first developed in our laboratory at Houston and described in a paper read before the Paleontological Society at Boston in 1921. This method has now come into general use in the Gulf Coast region and is giving excellent results. It is based, primarily, on occurrence of foraminifers either as individuals or in faunules, and we find it about as reliable in use as is the case with many molluscan faunas.

In the Idol Island well the samples from 1268 to 1800 feet showed the same assemblage of forms found in surface material taken near the top of the Alazan (Jackson) beds, while those from 1800 to 2500 correspond with the forms found in the Tantoyuca or lower Alazan. At 2500 feet there was a break evidenced by both lithologic and faunal changes. Between 2500 and 4200 feet the foraminiferal fauna is entirely new so far as we are aware. Apparently, this formation in its marine foraminiferal phase does not outcrop at the surface in Mexico. At about 4200 feet there was another change of material as the drill entered the Papagallos, and this carried the very characteristic fauna which we have been able to recognize in every sample of surface outcrop of this formation which we have had opportunity to study.

We had, therefore, in this well about 1700 feet of Eocene material between the known Jackson and known Cretaceous, the exact correlation of which we were unable to make other than that it was probably the coastal representative of some part of the Chicontopec of the interior region.

Within the last few days a series of samples has been received from a well in southern Angelina County, about one hundred miles north of Houston. The section as shown by these samples is almost entirely marine and generally highly fossiliferous.

The samples began at 930 feet. From that depth to 1127 the fauna is typically Jackson. There was then a break in samples to 2631 feet, below which the fauna was Claiborne in age. At 2800 feet the Queen City beds were found as non-fossiliferous sand 200 feet in thickness. The sample from 3003 feet was a core, highly fossiliferous. The foram fauna, which is abundant, contains only a single species found in the Claiborne, the remaining forms being absolutely different from those of that stage and from the Midway fauna, of which we have at least 100 collections. It is undoubtedly Wilcox in age. While the surface exposures of Wilcox are often fossiliferous, we know of none in which forams have heretofore been found. It is certainly the first discovery of such beds in Texas, and is of especial interest to us also in the fact that this fauna is practically identical with the one in the Idol Island well between 2500 and 4200 feet and especially with the forms below 3500 feet. The Texas fauna is more varied in genera and species, doubtless because it is a near-shore phase, while that of Mexico was laid down in deeper water. However, the dominant forms are the same in both and are not known in other formations in this region so far as we are aware.

A report on the geology of the Idol Island well is in preparation, which will give the details of which this is a brief summary.

E. T. DUMBLE

HOUSTON, TEXAS

BEHAVIOR OF THE THRESHER SHARK

NONE of the literature within my reach gives definite information as to the use of the extremely long, slender tail of the thresher shark (*Alopias vulpes*), although several writers refer to the general notion that it is used to frighten schools of fish in order to make them huddle close together. For that reason it seems to me that many non-specialists among readers of SCIENCE may be as much interested as specialists in a record of a recent observation near the end of

the pier belonging to the Scripps Institution at La Jolla. This point is about 1,000 feet from shore and the water is near thirty feet deep.

While taking my plankton collection at about 7:25 a. m., April 14, 1923, I heard a splash near by. Turning, I saw about one hundred feet distant a swirl in the water like that made by a California sea lion. A moment later a long, slender, compressed tail (about three feet long) flashed above the surface and lashed about like a coach whip. It evidently belonged to some shark-like creature with which I was not acquainted. This exhibit was quickly repeated once. The body was not visible at all.

At about 7:45, while draining some water through my filtration net I saw about fifty feet from the pier what appeared *at first* to be a "soup fin shark" (*Galeus zyopterus*). It was coming diagonally toward the surface and swimming rapidly. Almost immediately I noticed a small fish (possibly California smelt, *Atherinopsis californicus*, about ten inches long) frantically swimming just in front. A moment later the pursuer, a six-foot thresher shark, passed partly ahead of the victim (probably half its own length) when it turned quickly and gave the coach-whip lash with the tail which I had seen before. The victim was much confused, if not actually injured by the whiplike movement, which seemed to be very accurately aimed. The whip stroke was instantly repeated with very confusing speed, and it then became evident that the victim was seriously injured. It was, however, almost under the drip from my net, at which the shark was apparently frightened. The shark darted away and was not seen again. The victim sank, swimming feebly, then came to the surface and lay on its side awhile. Then it struggled feebly with head at surface, gasping. Finally it sank again until out of sight and was not seen again.

I was much impressed with the speed and skill with which the shark worked and with the accuracy shown in its strokes at a single flying target.

W. E. ALLEN

LA JOLLA, CALIFORNIA

ASYMMETRICAL ORATORY

IN the work of supervising class-room teachers during many years and in visiting class rooms in different parts of the country, I have frequently noted phenomena analogous to those described by Dr. W. Gilman Thompson (SCIENCE, March 16, 1923) as "right- and left-handedness in speakers."

Many teachers, especially when the class is large, focus their service upon a limited portion of the room to the almost complete neglect of the pupils in the marginal fringe. Whenever I brought this fact to the attention of teachers, I found that they were themselves unaware of it. On the other hand, I have met teachers who were aware of this tendency in themselves, and who attempted to counteract it by means of some mechanical device, such as seating plan or roll book, etc., to insure an equitable distribution of attention to all individuals.

The use of the right or left hand and arm to release the emotional strain for which the voice alone is not an adequate outlet may account for the asymmetrical presentation in the case of public speakers and orators. From my observation in schools I am inclined to attribute the limitation to some irregularity of vision. In many cases it is possible to detect deficient vision on the part of pupils by their posture and address.

This matter deserves more intensive and systematic study, both for the improvement of school-room technique and for the art of public speaking.

BENJ. C. GRUENBERG

NEW YORK

QUOTATIONS

MEDICAL PROGRESS

"EMOTIONAL tension," Sir Almroth Wright declared in a recent lecture on vaccination, "is intolerant of any intellectual *impasse*." He was describing in outline the steps by which modern medicine has progressed towards a clearer knowledge of disease and of the mechanism of the body's protection against disease. Hypotheses are always tentative; of the best of them it may be said that, in a sense, they are made to be broken. Thus it was "'the pain in the mind,' which is felt when one is appealed to and is powerless," to quote Sir Almroth again, which led Pasteur to revise his first theory of vaccination and so to achieve his great triumph over hydrophobia. Last week, at St. Mary's Hospital, Professor Dreyer, of Oxford, offered yet another extension of knowledge which is the outcome of revised opinions and changed ideas. His new treatment of tuberculosis, whether ultimately it stands or falls, is the last link in a chain extending back to Jenner. The chain is continuous, but its links are not, if the metaphor may be extended, of the same shape nor even of the same metal. In a series of monographs, of which we present some account to-day, Sir Almroth Wright has recently outlined his own revised opinions on the subject of vaccination against disease. These differ in many important respects from the views this pioneer held when he set himself to perfect the method of preventive inoculation against typhoid fever, which stood the world in so great stead during the years of the war. Sir Almroth no longer believes that our bodies elaborate a special and specific antidote against each germ which attacks them. Rather he takes the view that there is stored up in the white cells of the blood

a common stock of antidote which can be released very swiftly and which is capable of inflicting death on most of our microbic foes.

These are revolutionary opinions and it would be idle to pretend that, at present, they meet with general acceptance. Their importance, however, can not be disputed. Nor is it likely that the "pain in the mind" which gave them birth will suffer them to remain without the sustenance of continuous experimental proof. Vaccination is now fighting for first place among the weapons of cure. Thanks to Sir Almroth Wright, Professor Dreyer and others possessed of the same temper of mind, it has literally forced itself on the world. Failure in more than one direction has already been changed into conspicuous success; no failure has been accepted as inevitable or irremediable. It may be that this urgent spirit is about to win its greatest triumphs and that, as Mr. Neville Chamberlain suggested at Birmingham on Saturday, a new vista of hope is opening before our eyes. In any case the future is big with possibility, inasmuch as many minds in the scientific world at this time are held in that "emotional tension" from which all progress and discovery proceeds.—*The London Times.*

SCIENTIFIC BOOKS

The Life of Sir Ernest Shackleton, C.V.O., O.B.E. (Mil.), LL. D., with many illustrations. By HUGH ROBERT MILL, Heinemann, Ltd., London, 1923, pp. 312.

THAT truth may be stranger than fiction is occasionally proven in the career of a remarkable man, but seldom more strikingly than in the life of Sir Ernest Shackleton, the Antarctic explorer, whose sudden death so profoundly moved the entire civilized world. This account of his life by Dr. Mill, which is sponsored by Lady Shackleton, if we except the rather dull Part One, which deals with Shackleton's boyhood and youth, is a romance which grips the reader and fastens his attention to the very end.

Even more, perhaps, than others, readers already familiar with Sir Ernest's own narratives of his expeditions ("The Heart of the Antarctic" and "South") will here see the explorer in a new light. In this intimate portrayal by his friend Mill, Shackleton stands out not only as perhaps the best exponent of British pluck and endurance, but as the idealist with a strong passion for poetry—for the lofty sentiments of Browning, Tennyson and Wordsworth even more than for the strong liquor of Kipling and Service. A few stanzas from the hero's favorites have been inserted with rare skill at the headings of chapters. On occasion Sir Ernest wooed the muse himself and not wholly without success, as the following lines show, dedicated to the sailors who were his devoted companions in so many adventures:

> But since that vision left me
> I have looked on those sailor men
> As worthy the brightest idyll
> That poet could ever pen.

The biographer of Shackleton was well chosen, for Dr. Mill is a foremost authority on the history of Antarctic exploration as well as a geographer of distinction, and his intimate friendship for the explorer extended over the entire period of the latter's explorations. Attachment for his friend has not, however, blinded Dr. Mill to the fatal optimism which in Shackleton's business ventures seems to have lacked that fertility of resource held in check by a well-ordered judgment which in his exploring expeditions amounted almost to genius.

As a boy and in early youth Shackleton showed apparently no indication of the remarkable powers which in maturer years were to make him stand forth as one of the dominant figures in all polar exploration, and it is this which accounts for the dullness of the first part of the book. Shackleton was a boy of good ideals, quite religious, and of poetic sentiments. At Dulwich College, which he attended, near his home in Ireland, he made no strong impression either upon his teachers or upon his mates. Returning nineteen years after leaving college to preside at the award of prizes, he delighted the boys when he said that he had "never been so near a Dulwich prize before."

At sixteen Shackleton went to sea as an apprentice, and in the hard life of the sailing ships of the time rose in eleven years to the rank of second mate. Of conscientious scruples and of clean habits, he had little real fellowship with the rough sailors whose respect and even whose love and affection he later commanded in so remarkable a degree. A glimpse of what was in the heart of the young man we learn from something which he wrote when twenty-four:

> I would attain but the goal is that to which Aprile yearned. What can I call success? A few years' praise from those around and then—down to the grave with the knowledge that the best thing has been missed unless the world's success brings that to pass, and for me it seems a long ways off. . . .

Who, from anything recorded in the earlier chapters, would have suspected there was to come the hero who on his first independent polar expedition threw away a portion of the warm clothing so as to carry more food and by a supreme effort in the last étapes pushed nearer the goal; or that here was the leader of the forlorn hope steering a little whale-boat across eight hundred miles of the stormiest seas of the world to achieve the rescue of his party marooned on Ele-

phant Island? Hardly less remarkable was the escape from the drifting floe after the crushing of the *Endurance*. Here the situation called for patience in a leader popularly regarded as impetuous; yet it was he who now played the waiting game in opposition to his party and so saved them when the time was ripe.

In evaluating what was both Scott's and Shackleton's judgment with respect to one important matter, Dr. Mill takes a peculiarly British viewpoint when he says of the party's poor effort in dog driving, "it served to strengthen the fine old British tradition which Sir Clements Markham set such store by, that the best polar draught animals are the human members of the expedition. And in their hearts the *Discovery* people did not believe in dogs." To the reviewer Shackleton once defended the British use of ponies as a substitute for dogs on the ground that their noses were more generally above the heavy drifting snow, ignoring the more important considerations that ponies can not endure the cold, break through the snow, and soon finish, leaving to the human members of the party the heartbreaking work of dragging the sledges at a snail's pace. Fine tradition though it may be, this obsession of British explorers has cost terrible sacrifices. Scott's last expedition proved that the Antarctic summer is too short for men to safely venture to the pole with man-hauled sledges, and Shackleton must have reached the pole on his first expedition had he been fitted out with good dog trains.

The sense of humor which was always keen in Shackleton is well illustrated by a Christmas talk to children. In response to their applause he said: "Now you kids, I'll put you up to a good thing. If you want to see what sledging is like, go home and harness the baby to the coal scuttle and drive round the dining-room table, but don't tell your mother I told you."

After setting out on his last expedition Shackleton wrote:

> I love the fight and when things are easy I hate it, though when things are wrong I get worried. . . . I don't think I will ever go on a long expedition again. I shall be too old. [A little later he wrote:] Except as an explorer I am no good at anything. . . . I want to see the whole family comfortably settled and then coil up my ropes and rest. I think nothing of the world and the public. They cheer you one minute and howl you down the next. It is what one is oneself and what one makes of one's life that matters.

WILLIAM HERBERT HOBBS

Silurian. Maryland Geological Survey. Baltimore, The Johns Hopkins Press, 1923, roy. 8vo; 794 pp., 67 pl.

THE Maryland Geological Survey has just published the volume on the "Silurian" of Maryland, the eighth of the series of reports dealing with the systematic geology and paleontology of Maryland. Like the preceding volumes, this is the result of cooperative work on the part of specialists. While there is always the danger of a lack of uniformity in such cooperative undertakings, it also leads of necessity to clarifying discussions among the associates and to an illuminating discussion of problems from somewhat different angles. The latter is, to some extent, also the case in the Silurian of Maryland, for we find on the one hand a careful, conservative description, with numerous sections (largely by W. F. Prouty), of the geographic distribution, geologic, stratigraphic and paleontologic relations, as well as interstate correlation, of the Silurian by C. K. Swartz; and on the other hand a general statement of the American Silurian formation by E. O. Ulrich and R. Bassler, combining the well-known vigorous and incisive criticism of the senior author with the minute, painstaking investigations of the junior author and through this excellent combination furnishing, after much necessary destruction of antiquated views, highly important constructive additions to our knowledge. This is especially apparent in the case of the Clinton formation, which by means of the most detailed study of the Clinton ostracods is divided into a number of zones, the tracing of which into the adjacent state has, so to speak, solved the troublesome Clinton problem for us by establishing reliable datum planes for long-distance correlations. In looking over the many plates of endless species of similar ostracods of the Beyrichia type, one might well think that the limit of refinement in species discrimination had here been reached and passed, but after all the results obtained warrant the outlay of time and money. It is another illustration of the general postulate of biology transferred into faunal stratigraphy, which is that the foundation has first to be laid by unlimited analysis for that final synthesis which is to yield the underlying laws of the biologic procession, as well as of the incessant movements of land and sea in the history of the earth.

The Silurian fauna of Maryland, save the ostracods, is carefully described and illustrated by Swartz and Prouty.

The volume is well illustrated, without being padded, by diagrams, photographs of typical sections and paleogeographic maps (by Ulrich). This new addition to the stately series of Maryland reports is in every way a credit to the state geologist, his collaborators, and to the state which shows its progressive interest and laudable pride in the geology of its territory by this magnificent series of publications.

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SPECIAL ARTICLES

THE PARTHENOGENETIC DEVELOPMENT OF EGGS IN THE OVARY OF THE GUINEA PIG

A RELATIVELY far-going parthenogenetic development of eggs in the ovary of the guinea pig has been observed by us so far in thirty animals. It can therefore not be considered an exceptional occurrence. We observed these ovarian structures, which owe their origin to parthenogenesis, for the first time more than twenty years ago. But owing to their shape and situation, resembling those of ovarian follicles, we believed at that time that they originated in some way in the follicles. Very soon afterwards, however, the suggestion came to us that the structures observed bore a great resemblance to certain embryonal formations, and that, therefore, these bodies might really be due to a far-going parthenogenetic development of the ovum within the mammalian ovary. Definite proof for this interpretation we obtained when, in continuing our search for these structures, we found unmistakable embryonic structures corresponding to neural tube and to other embryonic formations in at least two, and probably in three, guinea pigs. In the large majority of the animals observed, the development proceeds to the formation of embryonal placenta rather than to the development of the embryonal organs proper. We found further confirmatory evidence when we succeeded in producing experimentally extrauterine pregnancy in the guinea pig. It thus became possible to observe eggs embedding themselves and developing in the peritoneal tissue between tube and uterus. In such an embryo developing from a fertilized egg, as well as in the ovarian extrauterine pregnancy which owes its origin to parthenogenesis, a retardation in the development of the embryo and a relative preponderance of placental structures occur, owing to the abnormal conditions under which development takes place. Under both conditions the developing placental structures are of the same character, and giant cells and plasmodia are produced; giant cells migrate into the surrounding tissue and are especially attracted by the blood-vessels; they may substitute the blood-vessel-endothelium and here, in contact with the blood, agglutinate into a syncytial layer. They also may penetrate into the blood stream.

We may assume that in both cases in contact with the host tissue, which is devoid of decidua and under the stimulus of the strange tissue, the early embryonic formations differentiate into placenta rather than into embryonic organs proper. Factors present in the blood-vessels act as a formative stimulus leading to the production of syncytia. There is no structure in the ovary outside of the ovum which can give rise to such formations in the guinea pig; neither the granulosa, nor the theca interna of follicles ever undergo any changes even remotely approaching these parthenogenetic formations. A careful study makes it certain that they are identical with embryonic and placental structures such as are produced in normal and particularly in extrauterine pregnancy in the guinea pig.

These parthenogenetic structures take a cyclic course; they develop through mitotic cell multiplication. After some time the unsatisfactory condition of nourishment, the unyieldiness of the tissue in which they are enclosed prevent their further development. Mitotic growth ceases. The host connective tissue encircles them, presses on them, invades them and thus they gradually disappear.

Not uncommonly hemorrhages occur in the structures just as they occur in the normal placenta. These hemorrhages are due to the ingrowth of blood-vessels into trophoblastic tissue which shows little resistance and to the rarefying action of the wandering giant cells. Furthermore, around the growing embryonic structures hyperemia is found and it seems that the process of ovulation especially is apt to lead to hemorrhages in these fragile tissues. Not only the greater part of the embryo, but even parts of the surrounding ovarian stroma may be destroyed through these hemorrhages. Under no other conditions have we observed hemorrhages of this character in the ovary of the guinea pig.

These embryonal formations develop in young as well as in older animals and especially also in animals which have been kept separated from males. I have observed them in guinea pigs which had not yet ovulated at the time of the development of these embryonal bodies; they may also develop during the latter part of pregnancy and in all these cases we can with certainty exclude a previous fertilization of the ovarian ovum. They, therefore, owe their origin to parthenogenesis.

As many as three embryonic structures may be found in the ovaries of a guinea pig at the same time; these multiple bodies may be situated either in one ovary or in both ovaries. This multiplicity suggests the conclusion that, in addition to local stimuli, some more general condition affecting the animal as a whole favors their development. So far we have not succeeded in producing them at will through various experimental procedures of a physical or physicochemical nature. The embryonic bodies originate in all probability in follicles during the early stages of atresia. At the time of ovulation such an atresia takes place en masse and this may therefore be a specially favorable period for their development; in some cases, however, we can exclude a preceding ovulation in the history of the animal in which they are found, and they must have originated in follicles becoming atretic at other periods of the sexual cycle.

Atresia of follicles may initiate not only processes of maturation in the egg, but also further-going changes which are not of a purely degenerative character, but consist in the formation of mitotic figures other than maturation spindles, and lead to the formation of segments with well-preserved nuclei. Such processes have been observed by ourselves as well as by various other investigators and recently new evidence of the occurrence of early segmentation in ovarian eggs has been brought forward by Newman and by Sansom. Our own findings of far-going parthenogenetic development in the ovarian egg of the guinea pig does not depend for recognition upon the interpretation of these early changes in the eggs of atretic follicles. On the contrary, the more than exceptional occurrence of the parthenogenetic embryonic structures described by us lends support to the interpretation of the changes observed in the eggs of atretic follicles as attempts at parthenogenetic development which in the large majority of cases prove abortive, but which apparently in certain cases overcome the obstacles to a further-going development.

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SUBSOIL ACIDITY

IN any forest association the various plants have their rootage systems at different levels in the soil, though for the most part in the upper portion. Secondary roots may be spread over a wide superficial area with an occasional plant sending a tap-root deeper. These relations have been recently reviewed by MacDougall,[1] who also quotes Sherff as stating that plants are able to live together because the main part of their absorbing systems are placed at different levels in the soil.

Study of soil conditions at these various levels, then, is essential to an understanding of physiological behavior and ecological relations of plants growing in the open. One condition is soil acidity, and of subsoil acidity a few studies have been made. Wherry,[2] in New Jersey, dug pits and tested at twenty-five centimeter intervals to a depth of one hundred centimeters, finding a marked decrease in acidity with depth. Salisbury,[3] working at Rothamsted, England, does not tell of his method but finds a decrease in acidity to a depth of thirty inches.

The writer has made borings in areas of soil types found in southeastern Pennsylvania, in all cases in wooded areas and as typical of the whole area as possible. Surface soil conditions have been reviewed in a previous paper.[4]

All sampling was done with a soil auger; an ordinary one and a half inch wood auger fitted with 22-inch joints of gaspipe and a handle which could be uncoupled and carried in the field in a canvas case. Borings could be made to 300 centimeters, but usually bedrock or a cherty subsoil was reached at 100 centimeters or less. Care was taken to keep the auger clean; upon removing it from the boring the outer part of the "core" was scraped off and some of the remainder was pressed into a container. Shell vials were tried but found to be too fragile; seriological test tubes of size 16 × 120 mm. were adopted, being carried in a cloth-lined case in the field. They were marked at 5 cc. and 15 cc. levels, were provided with clean corks and were carefully cleaned in distilled water each time after using.

In the field a sample was tamped lightly with a glass rod to the 5 cc. level and the tube was corked. Being brought to the laboratory (the same day usually, or within twenty-four hours) distilled water was added to the 15 cc. level and the soil was thoroughly stirred. The suspension settling, the extract was tested by the colorimetric method with Clark and Lubs standards of 0.2 pH interval. A simple type of comparator was constructed, using electric light screened by blue glass. Turbid solutions were diluted one half and compared with standards which had corresponding turbid solutions placed before them.

AVERAGE pH OF SUB-SOIL SAMPLES

Depth	Hagerstown loam	Chester loam	Manor loam	Dekalb loam	Conowingo loam
S	7.025	6.781	6.480	5.607	5.571
— 15 cm.	6.945	5.793	5.375	5.524	5.421
— 30 cm.	6.859	5.477	5.577	5.599	5.691
— 45 cm.	6.916	6.175	5.850	5.521	6.018
— 60 cm.	7.006	6.293	5.887	5.666	6.218
— 75 cm.	7.070	6.216	5.983	5.750	6.170
— 90 cm.	7.075	6.230	5.733	6.000	6.166
—105 cm.	7.100	6.233	.....	.....	.....

From tests of over five hundred samples pH values are given in the accompanying table, averaged to the third decimal place. It will be seen that in all cases there is an increase in acidity with depth to 15 or 30 cm., then a gradual decrease toward neutrality. The extent of this variation seems correlated with the productiveness of the soil, being least in the fertile Hagerstown loam.

The relation of these results to plant life, the significance of the variation in pH values with increasing depth, and the relation to microbiotic forms of the soil will be treated in a later paper.

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[1] MacDougall, W. B., 1922, "Symbiosis in a deciduous forest," *Bot. Gaz.*, v. 73, pp. 200–212.

[2] Wherry, E. T., 1920, "Observations on the soil acidity of Ericaceae and associated plants in the Middle Atlantic states," *Proc. Acad. Nat. Sci.*, Philadelphia, v. 72, pp. 84–113.

[3] Salisbury, E. J., 1922, "Stratification and hydrogen-ion concentration of the soil in relation to leaching and plant succession with special reference to woodlands," *Journ. Ecology*, v. 9, pp. 220–240.

[4] Kelley, A. P., 1922, "Plant indicators of soil types," *Soil Science*, V. 13, pp. 211–223.